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Raising Dairy Replacement Heifers: From Birth to Breeding

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High-producing dairy cows usually receive the greatest amount of attention on the farm, since maximizing efficiency of milk production will directly lead to higher profits. However, successful rearing of replacement heifers is also an excellent way to increase profits and is an area of management often neglected. It is important to be able to successfully raise all heifer calves born (mortality rates should be less than 5%), since about 30% of the milking herd will be culled each year.

By having a strong replacement program, the dairy producer will be able to replace culled cows with genetically superior heifers. The producer may also be able to cull the milking herd more vigorously, because superior replacement heifers would be readily available. In addition, maintaining a closed herd significantly reduces the chances of the introduction of disease.

Economically, a replacement heifer represents a large investment by the time she reaches 24 months of age. Actual rearing costs range from $1,100 to $1,300. Shown in Table 1 is a budget of rearing costs for replacement heifers. While a great amount of time and money is invested in these heifers, there is no immediate cash outlay for replacements; therefore, rearing costs are spread out over a longer period compared to buying heifers.

Table 1. Costs of raising replacement heifers.

Item	Amount	Cost
Feed		
Forage as hay equivalent $60 per ton	13,200 lb.	$396.00
Shelled corn $2.35 per bu.	21 bu.	49.35
Soybean meal $.08 per lb.	170 lb.	13.60
Dical phosphate $.12 per lb.	60 lb.	7.20
Trace mineralized salt $.06 per lb.	49 lb.	2.94
Milk replacer $.60 per lb.	40 lb.	24.00
		493.09
Nonfeed Items		
Bedding, $40 per ton	2,200 lb.	44.00
Veterinary costs		22.00
Breeding		25.00
Power and fuel		19.00
Supplies		19.40
Overhead		16.00
Interest		53.95
		199.35
Fixed Costs		
Buildings		150.00
Equipment		108.00
Heifer investment (interest, taxes, insurance)		105.38
		363.38
Labor $6 per hour	24 hours	144.00
Total		$1,119.82

Cited in *Dairy Herd Management*, Jan. 1986.

General Management

Before Birth

To be able to successfully and efficiently raise heifers, the producer must start the replacement program before the calf is born. Proper nutrition of the pregnant cow, especially during the final 6 to 8 weeks of gestation, is essential to assure the birth of a healthy calf. A 6-to 8-week dry period is necessary for several reasons: 1) body reserves of fat, protein, and minerals can be replenished during this non-lactating period, 2) it is an excellent time to treat for mastitis since the cow is not lactating and milk does not have to be withheld, and 3) it is beneficial to allow the mammary tissue to first involute and then regenerate for the next lactation. Items to consider when designing a dry cow management program

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include: 1) milk production during previous lactation, 2) prior health record, 3) body condition when dried off, 4) duration of the dry period, and 5) age. Therefore, individual attention should be given to each cow as she enters the dry cow pool. Studies have shown that allowing no dry period results in lower milk production during the next lactation.

A general nutritional recommendation is to have separate dry cow and milking cow feeding programs. Pregnant heifers require nutrients for both the unborn calf and for their own growth; therefore, they cannot be fed the same ration as mature, dry cows. The producer should avoid feeding excess energy during the dry period, since it will not enhance subsequent milk production and it may cause a higher incidence of ketosis and displaced abomasum during the early postpartum period. The amount of grain fed daily during the dry period should be restricted to .35 lb. per hundred lb. of body weight to insure sufficient consumption of quality forage. Limited feeding of quality corn silage (less than 50% of the total ration) is advised, since it is a high energy forage which could result in over-conditioned cows. In addition, the diet for dry cows should contain sufficient levels of selenium and vitamins A, D, and E.

The producer should know what level of calcium is present in the diet to avoid excess intake (recommended level is .6%, dry matter basis), otherwise, milk fever may result. Limiting calcium in the ration will cause the mechanisms involved in gut absorption of calcium to be active and operating for the upcoming calcium demand during the next lactation.

Prior to calving the producer should move the pregnant cow to a clean, dry maternity pen or suitable pasture, so she is separated from the herd where the producer can closely watch her. Most cows calve without problems; however, sometimes calving difficulties occur and assistance is required. If assistance is necessary (such as with large calves) and the calf is in normal position, obstetric chains may be used to apply traction. Chains are better than rope because chains can be sterilized. Calves that are in an abnormal position may require veterinary assistance.

After Birth

Once the calf is delivered, the producer should remove mucus from nostrils and make sure the calf is breathing. Holding the calf up by the rear legs will allow mucus to drain from the nostrils, or tickling the nostrils with a piece of straw will cause the calf to sneeze to clear mucus. The navel should be soaked with fresh tincture of iodine or another disinfectant to prevent bacterial infection through the navel. Maintaining minimal exposure to bacterial contamination will help get the calf off to a healthy start. It is also important to avoid contamination and/or injury to the cow's reproductive tract to minimize the risk of uterine infection during the postpartum period.

It is essential for the calf's survival to consume colostrum as soon after birth as possible; therefore, the producer should allow the calf to nurse the cow or make sure to hand feed colostrum with a nipple bottle. For example, a chilled calf will not be active and probably will not stand and nurse, whereas a chilled calf who has ingested colostrum will be more vigorous and will actively suckle the cow.

Calfhood

Keeping accurate calf records by including daily observations and treatments given can help in evaluating the success of the replacement program. Information to be recorded includes: animal identification, birthdate, sex, complications at birth (calving problems, milk fever), colostrum fed, location of birth, sickness and death dates, treatments given, dates for vaccination, weaning, deworming, identification changes, surgery, and ration changes. A reliable method of identifying the heifer throughout her life is of utmost importance.

Nutrition Management

Birth to 2 Months

The feeding program from birth to 2 months of age is extremely important, and colostrum management plays a vital role in a successful early feeding program. Colostrum is a secretion of the mammary gland produced prior to and shortly after parturition and is rich in energy, protein, vitamins A and D, iron, and immunoglobulins (antibodies). The calf is born with no immunity against pathogens; therefore, the degree of passive immunity achieved is directly related to the amount of colostrum fed, the immunoglobulin (Ig) content of the colostrum, and the amount absorbed in the intestines.

Time is of the essence in colostrum management. There is a rapid decline in the quality of colostrum after the first milking, and the efficiency of absorption across the intestinal wall into the bloodstream decreases after birth, with the maximum absorption occurring within the first few hours after birth.

A calf should receive colostrum at approximately 5% of body weight at the first milking within 15 to 30 minutes after birth; this is equivalent to 2 qt. or 4-5 lb. for large-breed calves and 1.5 qt. or 2-3 lb. for small-breed calves. Colostrum feeding (2 times/day) should continue for the first 3 to 4 days of life.

One way the producer can be sure that the calf is receiving enough Ig from the colostrum she is consuming is to use a colostrometer to measure the level of Ig present in the colostrum of the dam. Although a colostrometer will not indicate for which pathogens those Ig are specific,

the Ig level of colostrum is still useful information. Calves of dams with low Ig content (less than 40 milligrams Ig per ml) can be fed high quality colostrum (50 to 60 milligrams Ig per ml) from another cow. Refrigerating or freezing surplus high quality colostrum ensures that there will always be a source available when needed. Before using, frozen colostrum should be thawed slowly and brought to room temperature.

Daily feeding of whole milk or milk replacer at 4, 6, and 8 lb. for 50, 75, and 100 lb. calves, respectively, is recommended from 5 to 14 days of age. Whole milk or milk replacer feeding should be maintained until the calf is able to consume adequate amounts of dry feed. To insure sufficient nutrient intake, whole milk should not be diluted with water, and milk replacer should only be mixed with the recommended volume of water.

A high quality milk replacer should contain at least 20% crude protein (24% if plant protein is used), a minimum of 10% fat, 12,000 to 20,000 IU/lb. of vitamin A, and 3,000 to 6,000 IU/lb. of vitamin D. When purchasing a milk replacer, the producer should carefully read the ingredient tag, since the protein source and energy content vary among commercial milk replacers. Milk replacers will differ in energy content, but normally 2.1 oz. of milk replacer in 1 pint of water will replace 1 lb. of milk (if the milk replacer contains 15% fat and 24% crude protein). Therefore, 10 oz. replacer + 4 lb. water; 13 oz. replacer + 5.5 lb. water; and 16 oz. replacer + 7 lb. water are recommended per day for 50, 75, and 100 lb. calves, respectively. Calves should be individually fed to prevent the spread of disease, especially when most illness occurs prior to weaning.

Time of weaning should be determined by dry feed consumption rather than by age. Weaning a calf does not mean that it should receive less attention than a newborn. When the calf is drinking from a bucket, the producer should get it accustomed to feed by placing a handful of pelleted or coarsely ground 100% milk product prestarter into the pail. When the calf licks the bottom of the pail, it will eat some of the feed. Calf starter can be introduced when the calf consumes 1/2 lb. of prestarter per day; prestarter feed should be available after the first week of birth. A typical prestarter feed contains an antibiotic for scours and molasses in addition to the ingredients normally found in calf starter feed.

Calf starter should consist of 15 to 20% crude protein (this can be from plant sources), not more than 6 to 8% crude fiber, no urea or other sources of nonprotein nitrogen, fortification with vitamins A and D (2,000 and 300 IU per pound of starter, respectively), and trace mineralized salt. Water intake is closely related to starter intake. For example, in a study where no water was available, calves ate 1/3 less starter, and gains were decreased by 41%. Therefore, it is important to have fresh water available to insure maximum consumption of starter feed. A calf may be weaned when it's eating 1-1.5 lb. of dry feed per day plus milk depending upon the size of the calf (usually about 28 days of age). Calves should be handled as individuals; they should be weaned according to their response to calf starter and not their actual weight or age.

A forage such as hay should be available to calves at an early age. Corn silage or haylage along with starter will yield good growth rates. Two things to keep in mind if feeding corn silage: 1) corn silage is low in protein and 2) silage contains water, so too much should not be fed since the calf may not eat as much starter as needed if its gut is filled. To insure optimal growth rates (Table 2), the best quality hay available should be offered because this provides a good source of protein.

Table 2. Optimal Body Weight (lb.) and Heart-Girth (in.) of Dairy Heifers.*

Age (months)	Ayrshire		Brown Swiss and Holstein		Guernsey		Jersey	
	Body Weight	Heart Girth	Body Weight	Heart Girth	Body Weight	Heart Girth	Body Weight	Heart Girth
Birth	70	29	90	31	70	29	60	25
2	130	35	160	37	125	34	105	32
4	240	43	270	42	225	42	185	39
6	335	48	385	49	315	46	280	45
8	405	51	490	55	395	50	375	49
10	510	54	600	59	460	53	425	51
12	595	59	700	62	555	57	525	56
14	660	61	770	64	610	59	560	58
16	725	63	870	66	665	61	615	60
18	795	65	930	69	735	63	670	61
20	850	67	990	71	795	65	725	63
22	910	69	1100	73	835	67	765	65
24	980	70	1200	75	920	69	835	67

* Due to differences in body confirmation within a breed, these measurements should be regarded as approximations only.

Two Months to Calving

Good nutrition is needed for heifers to reach 80 to 85% of their mature body weight by 22 to 24 months. Average daily gain of 1.5 to 1.8 lb. is recommended for Holstein heifers to reach 1,200 lb. by 2 years of age. Size more than age dictates puberty, ideal breeding time, and whether calving problems occur. Dietary recommendations for 2 months to 1 year of age are: hay or haylage (17.5% protein, 56% TDN) and concentrate (14% protein, 80% TDN). At 90% dry matter, feeding 3.5 lb. of concentrate and ad libitum forage should yield the desired (75:25) forage to concentrate ratio.

For heifers ranging from 12 to 22 months of age, the ration may consist of a 100:0 forage to concentrate ratio (if high quality forage is available). One-half of the dry matter should consist of an alfalfa-grass mixture (hay or haylage), and the other half of corn silage. It is recommended that grain be fed (2 to 3 lb. per day) if corn silage is not available. Feed refusals left from cows can be used to feed these older heifers. However, excessive energy fed to heifers will have detrimental effects on later milk production; therefore, overfattening replacements should be avoided. Studies indicate that high-energy diets for pubertal heifers will result in a reduction of mammary tissue development and an increase in fat deposition in the immature mammary gland. Also, over-conditioned heifers at calving may have more calving problems and be more susceptible to ketosis. Conversely, undernutrition will also have dramatic negative effects on growth rate and age of puberty. At calving, a smaller heifer may experience dystocia and be unable to compete for bunk space at feeding. Figures 1 and 2 illustrate the differences between a healthy, well-fed Holstein heifer and a stunted, undernourished one.

A more rigid feeding program for replacement heifers can be utilized if standard feeding programs, like the one outlined above, have failed to promote adequate growth rates. Heifers are fed according to 4 different age groups: 4-6, 7-12, 13-18, and 19-22 months of age. The recommended crude protein (% of dry matter) for these rations are: 15-16%, 14-15%, 12% and 12% for the four groups, respectively. The diet should consist of 20-60%, 30-90%, 40-100%, and 40-100% forage for these groups, respectively. In the latter two groups (13-18 and 19-22 months of age), the dietary calcium and phosphorus levels should decrease, since less grain is fed to these animals as their growth rate decreases. This feeding program requires a higher level of management and more labor, but it should help heifers reach the proper size and body condition by breeding time.

Near Calving

From 2 months before calving to calving (24 months of age), heifers should be fed a ration similar to that fed the milking herd. The ration should consist of at least 3 to 4 lb. of grain per day in order to help heifers develop rumen microflora and to insure that the lining of the digestive tract will be adjusted to a ration of forage and concentrate at parturition. The absorption and utilization of minerals is also enhanced by feeding grain prior to parturition.

Once in the milking herd, first lactation heifers require 20% more nutrients (except vitamin A), while second lactation heifers require 10% more

Figure 1. A healthy, well-fed 13-month-old Holstein heifer.

nutrients than mature cows to allow for growth. This can be met by providing 4 to 6 lb. more concentrate to first calf heifers than what equivalent-sized mature cows require. Second lactation heifers will need 2 to 3 lb. more concentrate.

Dry cows or heifers fed concentrate at over .5 to .8% of bodyweight over a sustained period may enter the milking herd with depressed appetites and may be more susceptible to metabolic and infectious diseases at parturition. Sodium bicarbonate in the diet (at 1/4 lb. per day) for 3 to 7 days after parturition may help alleviate some of the digestive problems when heifers enter the milking herd.

Freshened heifers should gradually be fed increasing levels of concentrate. Heifers should be started at .8 to 1.0% bodyweight per day as dry grain equivalent and ad libitum forage, or, if using total mixed rations, heifers should be started with less than 50% concentrate dry matter. Then concentrate levels should be increased about 1/2 to 1 lb. per day, which is possible when individually feeding heifers. Feeding dry grain equivalent beyond 2 to 2.5% bodyweight per day should be avoided.

Health Management

Diarrhea

The most common disease encountered when raising replacement heifers is bacterial diarrhea (calf scours). Viruses, bacteria, improper nutrition, and poor environment cause diarrhea. Because 15 to 20% of calves that develop diarrhea die, treatment and prevention are critical. Diarrhea occurs frequently within the first 10 days of life.

Dehydration will often develop due to the loss of fluids caused by the diarrhea. Severely dehydrated calves will often have sunken eyes, and, when the skin is pinched, it will not spring back to its original shape when released.

When calves have diarrhea, the feeding of milk should be stopped. Electrolyte solutions should then be administered to prevent dehydration. Commercial or homemade electrolyte solutions (Table 3) may be fed, or an esophageal tube may be needed. In addition to electrolyte solutions, products similar to Pepto Bismol may be given in an attempt to slow the motility of the digestive tract. During recovery from diarrhea, the calf should be fed a mixture of half milk and half electrolyte solution, and the proportion of milk should be increased slowly until full feeding of milk has been resumed.

Table 3. Homemade Electrolyte Solutions.*

1/2 cup light Karo syrup
1/2 tablespoon baking soda
1/2 tablespoon salt
2 quarts warm water

or

1 can beef consomme
2 teaspoons Lite salt
2 teaspoons baking soda
1 pkg. dextrose (fruit pectin)
2 quarts warm water

* These solutions should be fed at a rate of two quarts 3 to 4 times per day.

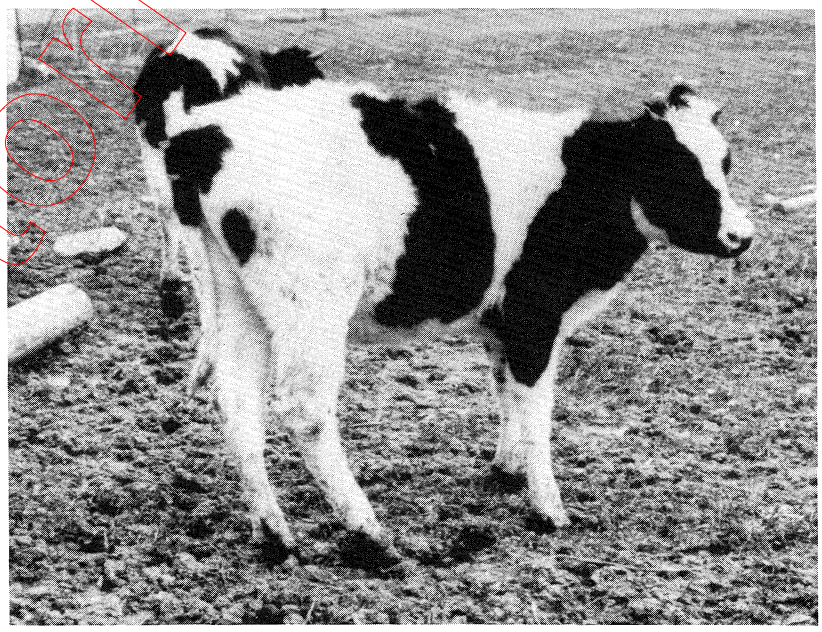

Figure 2. A stunted, undernourished 11-month-old Holstein heifer.

In many instances, diarrhea may be prevented by: 1) housing calves in clean, draft-free conditions, 2) providing colostrum soon after birth, and 3) vaccinations. For additional information, consult Purdue Extension publication VY-26, "Control of Calf Scours."

Pneumonia

Respiratory diseases in calves usually occur within the first 3 months of life. Many respiratory illnesses result in symptoms similar to those of the common cold: coughing, clear mucus discharge from the nostrils (yellow mucus in advanced cases), rapid and difficult breathing, fever (above 103°F), little interest in eating, and, frequently, diarrhea. Environmental conditions conducive to pneumonia are: 1) dirty, wet pens, 2) drafty areas, 3) crowded conditions, 4) fluctuations in ambient temperature, and 5) humid air due to inadequate ventilation.

If the calf is not receiving adequate nutrients (i.e. feeding diluted milk replacer), it may not be healthy or strong enough to avoid contracting pneumonia even when environmental conditions may be acceptable. Once a calf shows signs of respiratory disease, the producer should isolate the calf and be extra careful to properly clean the feeding equipment so as to avoid spreading the illness to other calves.

To treat cases of pneumonia, antibiotics effective against the causative microorganism can be used. Consultation with a veterinarian will help the producer select the proper treatment. When the calf is not eating, it is critical to maintain the calf's intake of fluids; therefore, electrolyte solutions should be administered to prevent dehydration. Vaccination programs to help prevent the incidence of respiratory diseases should be considered, especially if pneumonia is a recurring problem.

Vaccination Program

Vaccination programs are very important and should be discussed with a veterinarian. If disease outbreaks have occurred, routine vaccination may be necessary. For example, many herds have the following vaccination program: 1) vaccination of newborns for clostridium, Para-influenza 3 (PI-3), and Infectious Bovine Rhinotracheitis (IBR), 2) vaccination for Brucellosis and Bovine Viral Diarrhea (BVD) at 6 to 8 months of age, and 3) revaccination of heifers 4 weeks prior to breeding and after calving for IBR, BVD, and PI-3.

Drug Usage and Storage

It is important to employ proper storage and handling practices if antibiotics are used. Use of several different drugs should be avoided unless recommended by a veterinarian. The antibiotic should be stored in the recommended temperature environment according to the label, and the expiration date should be noted. Storing drugs in a refrigerator which provides cold but not freezing conditions is essential; therefore, an old refrigerator which may not provide a stable temperature is not recommended. Exposure to sunlight and contamination from dirty needles should also be avoided. Injecting ineffective drugs due to mishandling will not help the sick calf and may, in fact, be harmful.

Dehorning

The longer the producer waits to dehorn calves, the more stressful it becomes for the calves. Before the calf is 6 weeks old, there is very little bleeding when using a dehorning tube. With this method, the producer can scoop out the horn bud by applying pressure with a twisting motion. Dehorning paste is useful for calves younger than 2 weeks old. The horn bud should be scraped prior to paste application, and Vaseline should be placed around the horn base to avoid skin irritation. Calves should be kept isolated from each other or confined for a few hours if group-penned. Electric dehorners should be hot and placed over the horn bud in a circular motion until skin pulls away from the horn (about 10 to 30 seconds). The bud should then fall off easily.

Deworming

If not treated for parasites, heifers on pasture may not gain weight at the optimum rate, which could delay when they reach breeding weight. Deworming will also cause a sleeker, healthier appearance in cattle, since parasitism can result in weight loss, reduced appetite, and diarrhea. Knowledge of the type of internal parasite present in the herd as well as the life cycle of the invading organism can help the producer choose the proper dewormer. Consult Purdue Extension publications VY-20, "Stomach Worms of Cattle," and VY-51, "Treating for Internal Parasites of Cattle," for further information.

Breeding Management

Studies have shown that there is a profitable increase in milk production as body weight of the Holstein heifer, at calving, increases up to about 1,250 lb. Thus, Holstein heifers should be bred at 750-800 lb. A ration providing 1.5 lb. gain per day during pregnancy should yield a 1,250 lb. heifer at calving. In order to reach this goal, good reproduction programs are needed to be certain that heifers conceive at an appropriate time. Table 4 indicates the recommended breeding weights for heifers.

The most costly component of the reproductive program is undetected estrus or heat. Successful practices to aid in accurately detecting heat are: 1) visual observation of heifers 2-3 times a day, 2) avoidance of observing heifers during feeding, 3) use of detection aids as a sup-

Table 4. Breeding Weight for Heifers.

Breed	Body Weight
	(lb.)
Ayrshire	650-700
Brown Swiss	800-850
Guernsey	650-700
Holstein	750-800
Jersey	550-600

plement to visual observation, and 4) keeping good heat detection records.

The most reliable sign of heat is when a heifer stands immobile for a mount by a herdmate or bull. However, many secondary signs of estrus can be helpful when identifying cows in heat. See Purdue Extension publication AS-453, "Improving the Detection of Estrus in Dairy Cattle."

The use of artificial insemination when breeding heifers is extremely important, since the producer is able to select semen from a genetically superior sire to improve the potential productivity of the offspring. With good heat detection practices, artificial insemination can be properly timed so that acceptable conception rates can be obtained. With good insemination technique and proper heat detection, first service conception rates should be 75-80% for heifers.

Housing Management

The ultimate success of the dairy replacement program often depends upon proper housing. From birth to weaning, calves may be maintained either in "warm" or "cold" housing. "Warm" housing refers to conditions in which supplemental heat is provided in winter environments. "Cold" housing refers to conditions in which supplemental heat is not provided. Calf hutches are an example of "cold" housing. Both types of housing have pros and cons. Often, the producer determines the success of either housing type.

After weaning, calves are usually maintained in "cold" housing. The facilities for calves after weaning consist of either loose housing or free stall housing.

There are many acceptable forms of housing for replacement heifers. The primary requirement of all housing is to provide dry, draft-free environments. Manure removal and ease of feeding are also important considerations. For additional information on dairy housing, consult the Midwest Plan Service "Dairy Housing Handbook" (MWPS-7; $5.00). Your county Extension Office has a copy of this publication.

Summary and Recommendations

1. Pay attention to the body condition of dry cows, and feed them to attain proper body reserves so healthy calves are produced.
2. Get the calf off to a healthy start by providing a draft-free, clean, dry environment.
3. Make sure the newborn calf consumes colostrum as soon after birth as possible.
4. Do not wean calves until they adequately consume dry feed (about 1-1.5 lb. per day).
5. Manage the nutritional program for 12-22-month-old heifers to obtain properly-sized heifers for breeding and subsequent calving.
6. Provide the pregnant heifer with the milking herd ration prior to calving.
7. Continue to feed first and second lactation heifers for maintenance, lactation, and growth.
8. Dehorn calves at an early age to minimize stress.
9. Consult a veterinarian to formulate an appropriate vaccination program for replacement heifers.
10. Administer electrolyte solutions to avoid dehydration when a calf has scours.
11. Handle and store antibiotics properly because that is the only way to ensure their effectiveness.

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